Complete Summary

GUIDELINE TITLE

Intermittent positive pressure breathing: 2003 revision and update.

BIBLIOGRAPHIC SOURCE(S)

Sorenson HM, Shelledy DC. AARC clinical practice guideline. Intermittent positive pressure breathing--2003 revision & update. Respir Care 2003 May;48(5):540-6. [86 references] PubMed

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: American Association for Respiratory Care (AARC). AARC clinical practice guideline. Intermittent positive pressure breathing. Respir Care 1993 Dec;38(12):1189-95.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Pulmonary disease

GUIDELINE CATEGORY

Evaluation
Treatment

CLINICAL SPECIALTY

Family Practice
Internal Medicine
Pulmonary Medicine

INTENDED USERS

Respiratory Care Practitioners

GUIDELINE OBJECTIVE(S)

- To improve the consistency and appropriateness of respiratory care and serve as a guide for education and research
- To provide clinical practice guidelines on intermittent positive pressure breathing (IPPB)

TARGET POPULATION

Individuals with reduced pulmonary function, atelectasis or other pulmonary pathology who require intermittent positive pressure breathing

INTERVENTIONS AND PRACTICES CONSIDERED

Intermittent positive pressure breathing (IPPB)

MAJOR OUTCOMES CONSIDERED

- Effectiveness of intermittent positive pressure breathing (IPPB) for ventilation and aerosol delivery
- Degree of lung expansion following therapy
- Degree of dyspnea and chest discomfort during nebulized therapy
- Complications of treatment

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

Not stated

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Not stated

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Not stated

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

External Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Consultants to the Working Group may review the initial draft of the guideline. After the Working Group completes its review, the draft is reviewed by the entire Steering Committee and then by a Review Panel (i.e., persons engaged in all facets of the delivery of respiratory care who have volunteered to review drafts of the Guidelines before publication).

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Description/Definition

Intermittent positive pressure breathing (IPPB) is a technique used to provide short-term or intermittent mechanical ventilation for the purpose of augmenting lung expansion, delivering aerosol medication, or assisting ventilation. A caveat,

however, is that IPPB is not the therapy of first choice for delivering aerosol or a method of lung hyperinflation to be used in spontaneously breathing patients when other less expensive therapies can reliably meet the clinical objectives prescribed for the patient.

- IPPB can include pressure-, time-limited, as well as pressure, time, and flow-cycled ventilation.
- IPPB may be delivered to intubated and nonintubated patients

Settings

IPPB can be administered in settings that include hospital, clinic, extended care facility, and home.

Indications

- The need to improve lung expansion
    - The presence of clinically important pulmonary atelectasis when other forms of therapy have been unsuccessful (incentive spirometry, chest physiotherapy, deep breathing exercises, positive airway pressure) or the patient cannot cooperate
    - Inability to clear secretions adequately because of pathology that severely limits the ability to ventilate or cough effectively and failure to respond to other modes of treatment
- The need for short-term ventilatory support for patients who are hypoventilating as an alternative to tracheal intubation and continuous mechanical ventilation. Devices specifically designed to deliver noninvasive positive pressure ventilation (NPPV) should be considered.
- The need to deliver aerosol medication. (The guideline developers are not addressing aerosol delivery for patients on long-term mechanical ventilation.)
    - Some clinicians oppose the use of IPPB in the treatment of severe bronchospasm (acute asthma, unstable or status asthmaticus, and exacerbated chronic obstructive pulmonary disease [COPD]); however, a careful, closely supervised trial of IPPB as a medication delivery device when treatment using other techniques (metered-dose inhaler [MDI] or nebulizer) has been unsuccessful may be warranted.
    - IPPB may be used to deliver aerosol medications to patients with fatigue as a result of ventilatory muscle weakness (e.g., failure to wean from mechanical ventilation, neuromuscular disease, kyphoscoliosis, spinal injury) or chronic conditions in which intermittent ventilatory support is indicated (e.g., ventilatory support for home care patients and the more recent use of nasal intermittent positive pressure ventilation [IPPV] for respiratory insufficiency).
    - In patients with severe hyperinflation, IPPB may decrease dyspnea and discomfort during nebulized therapy.

Limitations of Procedure or Device

All of the mechanical effects of IPPB are short-lived--lasting $\leq$ an hour after treatment

- Based on the available literature, MDI or compressor-driven nebulizers should be considered the devices of choice for aerosol therapy to COPD and stable asthma patients.
- Only a very small percentage of the aerosol output deposits in the airway. Delivery of a therapeutic dose via IPPB may require as much as a tenfold increase in medication amount over MDI.
- Efficacy of device for ventilation and aerosol delivery is technique dependent (e.g., coordination, breathing pattern, selection of appropriate inspiratory flow, peak pressure, inspiratory hold).
- Efficacy is dependent on the design of the device (e.g., flow, volume, and pressure capability as well as aerosol output and particle size).
- IPPB is equipment- and labor-intensive as a method of delivery of aerosol.
- Limited portability, lack of instruction, and/or lack of 50-psi gas source may affect patient compliance.

Assessment of Need

- Presence of clinically significant atelectasis
- Reduced pulmonary function as evidenced by reductions in timed volumes, and vital capacity (e.g., forced expiratory volume in 1 second [FEV_1] < 65% predicted, forced vital capacity [FVC] < 70% predicted, maximum voluntary ventilation [MVV] < 50% predicted, or vital capacity [VC] < 10 mL/kg) precluding an effective cough
- Neuromuscular disorders or kyphoscoliosis with associated decreases in lung volumes and capacities
- Fatigue or muscle weakness with impending respiratory failure
- Presence of acute severe bronchospasm or exacerbated COPD that fails to respond to other therapy
    - Based on proven therapeutic efficacy, variety of medications, and cost-effectiveness, the MDI with a spacing device or holding chamber should be the first method to consider for administration of aerosol.
    - Regardless of the type of delivery device used (MDI with spacer or small-volume, large-volume, or ultrasonic nebulizer), it is important to recognize that the dose of the drug needs to be titrated to give the maximum benefit.
- With demonstrated effectiveness, the patient's preference for a positive pressure device should be honored.
- IPPB may be indicated in patients who are at risk for the development of atelectasis and are unable or unwilling to deep breathe without assistance.

Resources

- Equipment:
    - IPPB devices can be pneumatically driven or electrically powered. They are usually categorized as patient-triggered, pressure- or flow-cycled mechanical ventilators.
    - Most IPPB devices require a 45-55 psi gas pressure source (e.g., compressed gas cylinder, bulk gas system, external or internal air compressor).
    - Single-use IPPB devices are now available for providing short-term or intermittent mechanical ventilation, augmenting hyperinflation and delivering aerosols.

        - Single-use IPPB devices are not equipped with a redundant pop-off valve and thus should not be used with an endotracheal tube, and used only cautiously with a mask.
        - Tidal volume may be determined by using the tidal volume chart included with single-use IPPB instructions.
        - For single-use IPPB equipment at home, the rental/purchase of a 50 psi gas source is usually necessary.
        - Limited research indicates that single-use IPPB may be a safe and effective method of delivering IPPB without the need for conventional IPPB capital equipment.
    - IPPB circuitry includes large bore and connective tubing, nebulizer, adapters, and patient connection (mouthpiece, lip seal, mask, 15-mm endotracheal tube [ETT] connector), and if needed, nose clips.
    - Tissues, emesis basin, or sputum cup for collecting or disposing of expectorated sputum
    - Gloves, gown, goggles, and/or mask with face shield as indicated
    - Volume measuring device (hand-held spirometer or other volume-collecting bag)
    - Oral and/or endotracheal suction equipment
- Personnel: A continuum of education and skill levels is required for personnel who administer IPPB therapy. Different clinical situations warrant the degree of training necessary to provide optimal respiratory care.
    - Level I caregiver may be the provider of service after Level II personnel have established need for a specific device by patient assessment, and after the first administration has been completed. Level I personnel must demonstrate:
        - Ability to prepare, measure, and mix medication
        - Proper technique for administration of medication
        - Proper use of equipment, including adjustment of machine settings to meet patient demands
        - Effective cleaning of equipment
        - Proper disposal of wastes
        - Ability to encourage effective breathing patterns and coughing techniques
        - Ability to modify technique (after communication with physician) in response to recognized complications and adverse reactions or change in severity of symptoms as determined by observation, auscultation, and vital-signs determination
        - Ability to implement Standard Precautions and use proper infection control
    - Level II Personnel must exhibit all Level I skills and demonstrate:
        - Ability to perform physical exam--auscultation, inspection, percussion, and vital signs
        - Ability to assess patient condition and patient response to therapy
        - Ability to perform peak expiratory flowrate, spirometry, and ventilatory mechanics measurement
        - Proper use and knowledge of limitations of IPPB equipment and aerosol device and ability to fit mask and/or identify best application device for particular patient
        - Ability to recognize and respond to therapeutic changes, adverse response, and complications of aerosol medications

        - Ability to modify dosage of medication and/or frequency of administration as prescribed in response to severity of symptoms
        - Ability to negotiate care plan and modifications with physician and health care team
        - Understanding of effects of increased pressure on ventilation, perfusion, and sputum mobilization
        - Ability to modify technique in response to adverse reactions
        - Ability to instruct patient/family/caregiver in goals of therapy, and:
            - Proper technique for administration
            - Proper use of equipment
            - Cleaning of equipment
            - Breathing patterns and coughing techniques
            - Recognition of communications and technique modification in response to adverse reactions
            - Frequency modification in response to severity of symptoms
        - Understanding and compliance with Standard Precautions and infection control issues related to cleaning and maintaining equipment and handling of secretions and hazardous waste
    - Level III--Self-administration of IPPB. Patients who are to self-administer IPPB should demonstrate to the supervising clinician:
        - Proper technique for administration
        - Proper use of equipment
        - Proper cleaning of equipment
        - Ability to measure and mix medications
        - Optimal breathing patterns and coughing techniques
        - Technique modification in response to adverse reactions and duration or frequency modification in response to severity of symptoms

Monitoring

Items from the following list should be chosen as appropriate for the specific patient.

- Performance of machine trigger sensitivity, peak pressure, flow setting, F_{IO2} inspiratory time, expiratory time, plateau pressure, positive end-expiratory pressure (PEEP)
- Respiratory rate
- Delivered tidal volume
- Pulse rate and rhythm from electrocardiogram (ECG) if available
- Patient subjective response to therapy: pain, discomfort, dyspnea
- Sputum production: quantity, color, consistency
- Mental function
- Skin color
- Breath sounds
- Blood pressure
- Arterial hemoglobin saturation by pulse oximetry (if hypoxemia is suspected)
- Intracranial pressure (ICP) in patients for whom ICP is of critical importance
- Chest radiograph

Frequency

- Critical care: Every 1-6 hours for intermittent positive pressure breathing (IPPB) as tolerated. IPPB order should be re-evaluated at least every 24 hours based on assessments during individual treatments.
- Acute/home care patients:
    - Common strategies for IPPB vary from two times a day (b.i.d.) to four times a day (q.i.d). Frequency should be determined by assessing patient response to therapy.
    - For acute care patients, order should be reevaluated based on patient response to therapy at least every 72 hours or with any change of patient status.
    - Home care patients should be reevaluated periodically and with any change of status.

Infection Control

- Caregivers should implement Standard Precautions and appropriate guidelines for prevention of tuberculosis transmission.
- Caregivers should observe all infection control guidelines posted for patients.
- All reusable equipment should be disinfected between patients.
- Nebulizers/IPPB circuits should be changed between patients, when visibly soiled, or according to institutional infection control policy.
- IPPB machines/manifolds can be fitted with a scavenger or filter system to prevent aerosol from being released outside the immediate treatment areas.
- Nebulizers should not be rinsed with tap water between treatments. Rather, they should be rinsed with sterile water or sterile saline and allowed to air dry.

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of evidence supporting each recommendation is not specifically stated. The guideline is developed from a thorough review of the literature, surveys of current practice, and the expertise of the members of the Working Group.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

- Appropriate utilization of intermittent positive pressure breathing (IPPB)
- Improved pulmonary function in patients receiving IPPB, as reflected by the following:
    - A minimum delivered tidal volume of at least one-third of the predicted inspiratory capacity

- Improved forced expiratory volume in one second (FEV_1) or peak flow increase
- Cough more effective with treatment
- Secretion clearance enhanced as a consequence of deep breathing and coughing
- Chest x-ray improved
- Breath sounds improved
- Favorable patient subjective response

POTENTIAL HARMS

- Increased airway resistance and work of breathing
- Barotrauma, pneumothorax
- Nosocomial infection
- Hypocarbia
- Hemoptysis
- Hyperoxia when oxygen is the gas source
- Gastric distention
- Impaction of secretions (associated with inadequately humidified gas mixture)
- Psychological dependence
- Impedance of venous return
- Exacerbation of hypoxemia
- Hypoventilation or hyperventilation
- Increased mismatch of ventilation and perfusion
- Air trapping, auto positive end-expiratory pressure (auto-PEEP), overdistended alveoli

CONTRAINDICATIONS

CONTRAINDICATIONS

There are several clinical situations in which intermittent positive pressure breathing (IPPB) should not be used. With the exception of untreated tension pneumothorax, most of these contraindications are relative:

- Tension pneumothorax (untreated)
- Intracranial pressure (ICP) > 15 mm Hg
- Hemodynamic instability
- Recent facial, oral, or skull surgery
- Tracheoesophageal fistula
- Recent esophageal surgery
- Active hemoptysis
- Nausea
- Air swallowing
- Active untreated tuberculosis
- Radiographic evidence of bleb
- Singulation (hiccups)

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

Assessment of outcome of intermittent positive pressure breathing (IPPB):

- For lung expansion therapy, a minimum delivered tidal volume of at least 1/3 of the predicted inspiratory capacity [IC] (1/3 x 50 mL/kg) has been suggested. This corresponds to approximately 1200 mL in a 70 kg adult patient.
- An increase in FEV_1 (forced expiratory volume in 1 second) or peak flow increase
- Cough more effective with treatment
- Secretion clearance enhanced as a consequence of deep breathing and coughing
- Chest radiograph improved
- Breath sounds improved
- Favorable patient subjective response

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better
Living with Illness

IOM DOMAIN

Effectiveness
Safety

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Sorenson HM, Shelledy DC. AARC clinical practice guideline. Intermittent positive pressure breathing--2003 revision & update. Respir Care 2003 May;48(5):540-6. [86 references] PubMed

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1993 Dec (revised 2003)

GUIDELINE DEVELOPER(S)

American Association for Respiratory Care - Professional Association

SOURCE(S) OF FUNDING

American Association for Respiratory Care (AARC)

GUIDELINE COMMITTEE

Aerosol Therapy Guidelines Committee

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Primary Authors: Helen M. Sorenson, MA, RRT, FAARC; David C. Shelledy, PhD, RRT

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: American Association for Respiratory Care (AARC). AARC clinical practice guideline. Intermittent positive pressure breathing. Respir Care 1993 Dec;38(12):1189-95.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) the American Association for Respiratory Care (AARC) Web site.

Print copies: Available from the American Association for Respiratory Care (AARC), CPG Desk, 11030 Ables Ln, Dallas, TX 75229-4593; Web site: www.aarc.org.

AVAILABILITY OF COMPANION DOCUMENTS

None available

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on November 30, 1998. The information was verified by the guideline developer on December 15, 1998. This summary was updated by ECRI on August 20, 2003.

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